

1. (canceled)
2. (Original) A network connection system for connecting a first communication network and a plurality of user terminals when a second communication network is interposed between said first communication network and said plurality of user terminals, said second communication network employing a second protocol different from a first protocol employed in said first communication network, said system comprising:
- a scheduling apparatus including:
 - a classification processing unit for classifying data conforming to said first protocol received from said communication network based on quality guaranteed classes set thereto;
 - an overhead amount correction unit for correcting an overhead amount between a data rate associated with said first protocol and a data rate associated with said second protocol to convert received rate information on said second protocol to the rate based on said first protocol;
 - a weighting coefficient calculation unit for calculating a weighting coefficient based on said rate calculated by said overhead amount correction unit such that a minimally guaranteed rate is assured for a minimum rate guaranteed class among classes classified by said classification processing unit;

21 a weighting scheduler for scheduling data conforming to said
22 first protocol of said minimum rate guaranteed class and of a
23 weighting applied class among said classified classes based on the
24 weighting coefficient calculated by said weighting coefficient
25 calculation unit to deliver the data in accordance with the scheduling;
26 and
27 a scheduler for scheduling the data conforming to said first
28 protocol from said weighting scheduler such that the data conforming
29 to said first protocol is delivered at a transmission rate equal to or
30 lower than said rate calculated by said overhead amount correction unit
31 to deliver the data in accordance with the scheduling;
32 a protocol converter for converting the data conforming to said first
33 protocol after said scheduling apparatus has shaped the transmission rate
34 therefor to data conforming to said second protocol; and
35 a multiplexer including a current data detector for supplying said
36 scheduling apparatus with said rate information as indicative of a currently set
37 reception rate for said user terminals, said multiplexer being configured to
38 transmit to each of said user terminals the data conforming to said second
39 protocol from said protocol converter or the data conforming to said first
40 protocol after said scheduling apparatus has shaped the transmission rate
41 therefor.

1 3. (Original) A network connection system for connecting a first
2 communication network and a plurality of user terminals when a second
3 communication network is interposed between said first communication
4 network and said plurality of user terminals, said second communication
5 network employing a second protocol different from a first protocol employed
6 in said first communication network, said system comprising:

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7 a scheduling apparatus including:
8 a classification processing unit for classifying data conforming
9 to said first protocol received from said communication network based
10 on quality guaranteed classes set thereto;
11 an overhead amount correction unit for correcting an overhead
12 amount between a data rate associated with said first protocol and a
13 data rate associated with said second protocol to convert received rate
14 information on said second protocol to the rate based on said first
15 protocol;
16 a weighting coefficient calculation unit for calculating a
17 weighting coefficient based on said rate calculated by said overhead
18 amount correction unit such that a minimally guaranteed rate is assured
19 for the minimum rate guaranteed class among classes classified by said
20 classification processing unit;
21 a weighting scheduler for scheduling data conforming to said
22 first protocol of said minimum rate guaranteed class and of a
23 weighting applied class among said classified classes based on the
24 weighting coefficient calculated by said weighting coefficient
25 calculation unit to deliver the data in accordance with the scheduling;
26 and
27 a preferential control scheduler for scheduling the data
28 conforming to said first protocol from said weighting scheduler, and
29 data conforming to said first protocol of a best-effort class among said
30 classified classes such that the data conforming to said first protocol is
31 delivered at a transmission rate equal to or lower than said rate
32 calculated by said overhead amount correction unit, and for
33 preferentially scheduling the data conforming to said first protocol
34 from said weighting scheduler, and delivering the data conforming to

35 said first protocol of the best-effort class at a timing at which there is
36 no data conforming to said first protocol from said weighting
37 scheduler;
38 a protocol converter for converting the data conforming to said first
39 protocol after said scheduling apparatus has shaped the transmission rate
40 therefor to data conforming to said second protocol; and
41 a multiplexer including a current data detector for supplying said
42 scheduling apparatus with said rate information as indicative of a currently set
43 reception rate for said user terminals, said multiplexer being configured to
44 transmit to each of said user terminals the data conforming to said second
45 protocol from said protocol converter or the data conforming to said first
46 protocol after said scheduling apparatus has shaped the transmission rate
47 therefor.

1 4. (Original) A network connection system for connecting a first
2 communication network and a plurality of user terminals when a second
3 communication network is interposed between said first communication
4 network and said plurality of user terminals, said second communication
5 network employing a second protocol different from a first protocol employed
6 in said first communication network, said system comprising:
7 a scheduling apparatus including:
8 a classification processing unit for classifying data conforming
9 to said first protocol received from said communication network based
10 on quality guaranteed classes set thereto;
11 a rate measuring unit for measuring a transmission rate for a
12 preferential class among said classified classes;
13 an overhead amount correction unit for correcting an overhead
14 amount between a rate based on said second protocol and a rate based

15 on said first protocol to convert received rate information on said
16 second protocol to the rate based on said first protocol;
17 a weighting coefficient calculation unit for calculating a
18 weighting coefficient based on said rate calculated by said overhead
19 amount correction unit and the transmission rate for the preferential
20 class measured by said rate measuring unit such that a minimally
21 guaranteed rate is assured for the minimum rate guaranteed class
22 among the classes classified by said classification processing unit;
23 a weighting scheduler for scheduling data conforming to said
24 first protocol of said minimum rate guaranteed class and of a
25 weighting applied class among said classified classes based on the
26 weighting coefficient calculated by said weighting coefficient
27 calculation unit to deliver the data in accordance with the scheduling;
28 and
29 a preferential control scheduler for scheduling the data
30 conforming to said first protocol of said preferential class, the data
31 conforming to said first protocol from said weighting scheduler, and
32 data conforming to said first protocol of a best-effort class among said
33 classified classes such that the data conforming to said first protocol is
34 delivered at a transmission rate equal to or lower than said rate
35 calculated by said overhead amount correction unit, and for
36 preferentially scheduling the data conforming to said first protocol of
37 said preferential class, preferentially scheduling the data conforming to
38 said first protocol from said weighting scheduler at a timing at which
39 there is no data conforming to said first protocol of said preferential
40 class, and delivering the data conforming to said first protocol of the
41 best-effort class at a timing at which there is no data conforming to
42 said first protocol from said weighting scheduler;

43 a protocol converter for converting the data conforming to said first
44 protocol after said scheduling apparatus has shaped the transmission rate
45 therefor to data conforming to said second protocol; and
46 a multiplexer including a current data detector for supplying said
47 scheduling apparatus with said rate information as indicative of a currently set
48 reception rate for said user terminals, said multiplexer being configured to
49 transmit to each of said user terminals the data conforming to said second
50 protocol from said protocol converter or the data conforming to said first
51 protocol after said scheduling apparatus has shaped the transmission rate
52 therefor.

1 5. (Original) A network connection system for connecting a first
2 communication network and a plurality of user terminals when a second
3 communication network is interposed between said first communication
4 network and said plurality of user terminals, said second communication
5 network employing a second protocol different from a first protocol employed
6 in said first communication network, said system comprising:
7 a scheduling apparatus including:
8 a classification processing unit for classifying data conforming
9 to said first protocol received from said communication network based
10 on quality guaranteed classes set thereto;
11 a rate measuring unit for measuring a transmission rate for a
12 preferential class among said classified classes;
13 an overhead amount correction unit for correcting an overhead
14 amount between a rate based on said second protocol and a rate based
15 on said first protocol to convert received rate information on said
16 second protocol to the rate based on said first protocol;

17 a preferential class upper limit setting unit, operative when the
18 difference between the transmission rate of the data conforming to said
19 first protocol of the preferential class as measured by said rate
20 measuring unit and said rate calculated by said overhead amount
21 correction unit is lower than a minimally guaranteed rate for a
22 minimum rate guaranteed class among the classes classified by said
23 classification processing unit, for setting an upper limit to the
24 transmission rate for said preferential class for shaping, such that the
25 minimally guaranteed rate can be assured for said minimum rate
26 guaranteed class;

27 a weighting coefficient calculation unit, operative when said
28 preferential class upper limit setting unit does not set the upper limit,
29 for calculating a weighting coefficient based on said rate calculated by
30 said overhead amount correction unit and the transmission rate for the
31 preferential class measured by said rate measuring unit such that the
32 minimally guaranteed rate is assured for the minimum rate guaranteed
33 class among the classes classified by said classification processing
34 unit, said weighting coefficient calculation unit being further operative
35 when said preferential class upper limit setting unit sets the upper
36 limit, for calculating a weighting coefficient based on said rate
37 calculated by said overhead amount correction unit and the upper limit
38 rate set by said preferential class upper limit setting unit such that the
39 minimally guaranteed rate is assured for said minimum rate guaranteed
40 class;

41 a weighting scheduler for scheduling data conforming to said
42 first protocol of said minimum rate guaranteed class and of a
43 weighting applied class among said classified classes based on the
44 weighting coefficient calculated by said weighting coefficient

45 calculation unit to deliver the data in accordance with the scheduling;
46 and
47 a preferential control scheduler for scheduling the data
48 conforming to said first protocol of said preferential class, the data
49 conforming to said first protocol from said weighting scheduler, and
50 data conforming to said first protocol of a best-effort class among said
51 classified classes, such that the data conforming to said first protocol is
52 delivered at a transmission rate equal to or lower than said rate
53 calculated by said overhead amount correction unit, and for
54 preferentially scheduling the data conforming to said first protocol of
55 said preferential class, preferentially scheduling the data conforming to
56 said first protocol from said weighting scheduler at a timing at which
57 there is no data conforming to said first protocol of said preferential
58 class, and delivering the data conforming to said first protocol of the
59 best-effort class at a timing at which there is no data conforming to
60 said first protocol from said weighting scheduler;
61 a protocol converter for converting the data conforming to said first
62 protocol after said scheduling apparatus has shaped the transmission rate
63 therefor to data conforming to said second protocol; and
64 a multiplexer including a current data detector for supplying said
65 scheduling apparatus with said rate information as indicative of a currently set
66 reception rate for said user terminals, said multiplexer being configured to
67 perform DSL processing using telephone lines to transmit to each of said user
68 terminals the data conforming to said second protocol from said protocol
69 converter or the data conforming to said first protocol after said scheduling
70 apparatus has shaped the transmission rate therefor.

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1 6. (Original) A network connection system for connecting a first
2 communication network and a plurality of user terminals when a second
3 communication network is interposed between said first communication
4 network and said plurality of user terminals, said second communication
5 network employing a second protocol different from a first protocol employed
6 in said first communication network, said system comprising:
7 a scheduling apparatus including:
8 a classification processing unit for classifying data conforming
9 to said first protocol received from said communication network based
10 on quality guaranteed classes set thereto;
11 an overhead amount correction unit for correcting an overhead
12 amount between a rate based on said second protocol and a rate based
13 on said first protocol to convert received rate information on said
14 second protocol to the rate based on said first protocol;
15 a weighting coefficient calculation unit for calculating a
16 weighting coefficient based on said rate calculated by said overhead
17 amount correction unit and the transmission rate for a preferential class
18 among said classified classes using information fed back from said
19 user terminals such that a minimally guaranteed rate is assured for the
20 minimum rate guaranteed class among the classes classified by said
21 classification processing unit;
22 a weighting scheduler for scheduling data conforming to said
23 first protocol of said minimum rate guaranteed class and of a
24 weighting applied class among said classified classes based on the
25 weighting coefficient calculated by said weighting coefficient
26 calculation unit to deliver the data in accordance with the scheduling;
27 and

28 a preferential control scheduler for scheduling the data
29 conforming to said first protocol of said preferential class, the data
30 conforming to said first protocol from said weighting scheduler, and
31 data conforming to said first protocol of a best-effort class among said
32 classified classes such that the data conforming to said first protocol is
33 delivered at a transmission rate equal to or lower than said rate
34 calculated by said overhead amount correction unit, and for
35 preferentially scheduling the data conforming to said first protocol of
36 said preferential class, preferentially scheduling the data conforming to
37 said first protocol from said weighting scheduler at a timing at which
38 there is no data conforming to said first protocol of said preferential
39 class, and delivering the data conforming to said first protocol of the
40 best-effort class at a timing at which there is no data conforming to
41 said first protocol from said weighting scheduler;
42 a protocol converter for converting the data conforming to said first
43 protocol after said scheduling apparatus has shaped the transmission rate
44 therefor to data conforming to said second protocol; and
45 a multiplexer including a current data detector for supplying said
46 scheduling apparatus with said rate information as indicative of a currently set
47 reception rate for said user terminals, said multiplexer being configured to
48 perform DSL processing using telephone lines to transmit to each of said user
49 terminals the data conforming to said second protocol from said protocol
50 converter or the data conforming to said first protocol after said scheduling
51 apparatus has shaped the transmission rate therefor.

1 7. (Original) A network connection system for connecting a first
2 communication network and a plurality of user terminals when a second
3 communication network is interposed between said first communication

4 network and said plurality of user terminals, said second communication
5 network employing a second protocol different from a first protocol employed
6 in said first communication network, said system comprising:
7 a scheduling apparatus including:
8 a classification processing unit for classifying data conforming
9 to said first protocol received from said communication network based
10 on quality guaranteed classes set thereto;
11 an overhead amount correction unit for correcting an overhead
12 amount between a rate based on said second protocol and a rate based
13 on said first protocol to convert received rate information on said
14 second protocol to the rate based on said first protocol;
15 a preferential class upper limit setting unit, operative when the
16 difference between the transmission rate for a preferential class among
17 said classified classes determined to be using information fed back
18 from said user terminals and said rate calculated by said overhead
19 amount correction unit is lower than a minimally guaranteed rate for a
20 minimum rate guaranteed class among the classes classified by said
21 classification processing unit, for setting an upper limit to the
22 transmission rate for said preferential class for shaping such that the
23 minimally guaranteed rate can be assured for said minimum rate
24 guaranteed class;
25 a weighting coefficient calculation unit, operative when said
26 preferential class upper limit setting unit does not set the upper limit,
27 for calculating a weighting coefficient based on said rate calculated by
28 said overhead amount correction unit and the transmission rate for the
29 preferential class such that the minimally guaranteed rate is assured for
30 said minimum rate guaranteed class, said weighting coefficient
31 calculation unit being further operative when said preferential class

32 upper limit setting unit sets the upper limit, for calculating a weighting
33 coefficient based on said rate calculated by said overhead amount
34 correction unit and the upper limit rate set by said preferential class
35 upper limit setting unit such that the minimally guaranteed rate is
36 assured for said minimum rate guaranteed class;

37 a weighting scheduler for scheduling data conforming to said
38 first protocol of said minimum rate guaranteed class and of a
39 weighting applied class among said classified classes based on the
40 weighting coefficient calculated by said weighting coefficient
41 calculation unit to deliver the data in accordance with the scheduling;
42 and

43 a preferential control scheduler for scheduling the data
44 conforming to said first protocol of said preferential class, the data
45 conforming to said first protocol from said weighting scheduler, and
46 data conforming to said first protocol of a best-effort class among said
47 classified classes such that the data conforming to said first protocol is
48 delivered at a transmission rate equal to or lower than said rate
49 calculated by said overhead amount correction unit, and for
50 preferentially scheduling the data conforming to said first protocol of
51 said preferential class, preferentially scheduling the data conforming to
52 said first protocol from said weighting scheduler at a timing at which
53 there is no data conforming to said first protocol of said preferential
54 class, and delivering the data conforming to said first protocol of the
55 best-effort class at a timing at which there is no data conforming to
56 said first protocol from said weighting scheduler;

57 a protocol converter for converting the data conforming to said first
58 protocol after said scheduling apparatus has shaped the transmission rate
59 therefor to data conforming to said second protocol; and

60 a multiplexer including a current data detector for supplying said
61 scheduling apparatus with said rate information as indicative of a currently set
62 reception rate for said user terminals, said multiplexer being configured to
63 perform DSL processing using telephone lines to transmit to each of said user
64 terminals the data conforming to said second protocol from said protocol
65 converter or the data conforming to said first protocol after said scheduling
66 apparatus has shaped the transmission rate therefor.

1 8-11. (canceled)

1 12. (original) A traffic shaping method, in a network connection system for
2 connecting a communication network and a plurality of user terminals, for
3 shaping a transmission rate for data conforming to a first protocol from said
4 communication network, said method comprising the steps of:
5 classifying data conforming to said first protocol received from said
6 communication network based on quality guaranteed classes set thereto;
7 correcting an overhead amount between a rate based on a second
8 protocol and a rate based on said first protocol to convert received rate
9 information on said second protocol to the rate based on said first protocol;
10 calculating a weighting coefficient such that a minimally guaranteed
11 rate is assured for a minimum rate guaranteed class among said classified
12 classes based on said calculated rate;
13 scheduling data conforming to said first protocol of said minimum rate
14 guaranteed class and of a weighting applied class among said classified classes
15 based on the calculated weighting coefficient to deliver the data in accordance
16 with the scheduling; and
17 scheduling the data conforming to said first protocol after said
18 weighting, and data conforming to said first protocol of a best-effort class

19 among said classified classes, such that the data conforming to said first
20 protocol is delivered at a transmission rate equal to or lower than said
21 calculated rate, and for preferentially scheduling the data conforming to said
22 first protocol after said weighting, so that the data conforming to said first
23 protocol of said best effort class is delivered at a timing at which there is no
24 data conforming to said first protocol after said weighting.

1 13. (canceled)

1 14. (original) A traffic shaping method, in a network connection system for
2 connecting a communication network and a plurality of user terminals, for
3 shaping a transmission rate for data conforming to a first protocol from said
4 communication network, said method comprising the steps of:
5 classifying data conforming to said first protocol received from said
6 communication network based on quality guaranteed classes set thereto;
7 measuring a transmission rate for a preferential class among said
8 classified classes;
9 correcting an overhead amount between a rate based on a second
10 protocol and a rate based on said first protocol to convert received rate
11 information on said second protocol to the rate based on said first protocol;
12 calculating a weighting coefficient based on said calculated rate and
13 the transmission rate measured for the preferential class such that a minimally
14 guaranteed rate is assured for a minimum rate guaranteed class among the
15 classified classes;
16 scheduling data conforming to said first protocol of said minimum rate
17 guaranteed class and of a weighting applied class among said classified classes
18 based on the calculated weighting coefficient to deliver the data in accordance
19 with the scheduling; and

20 scheduling the data conforming to said first protocol of said
21 preferential class, the data conforming to said first protocol after said
22 weighting, and data conforming to said first protocol of a best-effort class
23 among said classified classes such that the data conforming to said first
24 protocol is delivered at a transmission rate equal to or lower than said
25 calculated rate, and for preferentially scheduling the data conforming to said
26 first protocol of said preferential class, preferentially scheduling the data
27 conforming to said first protocol after said weighting at a timing at which
28 there is no data conforming to said first protocol of said preferential class, and
29 delivering the data conforming to said first protocol of the best-effort class at a
30 timing at which there is no data conforming to said first protocol after said
31 weighting.

1 15. (original) A traffic shaping method, in a network connection system for
2 connecting a communication network and a plurality of user terminals, for
3 shaping a transmission rate for data conforming to a first protocol from said
4 communication network, said method comprising the steps of:
5 classifying data conforming to said first protocol received from said
6 communication network based on quality guaranteed classes set thereto;
7 measuring a transmission rate for a preferential class among said
8 classified classes;
9 correcting an overhead amount between a rate based on said second
10 protocol and a rate based on said first protocol to convert received rate
11 information on said second protocol to the rate based on said first protocol;
12 when the difference between said measured transmission rate of the
13 data conforming to said first protocol of the preferential class and said
14 calculated rate is lower than a minimally guaranteed rate for a minimum rate
15 guaranteed class among said classified classes, setting an upper limit to the

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16 transmission rate for said preferential class for shaping such that the minimally
17 guaranteed rate can be assured for said minimum rate guaranteed class;
18 calculating a weighting coefficient based on said calculated rate and
19 said transmission rate measured for the preferential class such that a minimally
20 guaranteed rate is assured for said minimum rate guaranteed class, when the
21 upper limit rate is not set for said preferential class, and calculating a
22 weighting coefficient based on said calculated rate and said set upper limit rate
23 such that the minimally guaranteed rate is assured for said minimum rate
24 guaranteed class when the upper limit rate is set for said preferential class;
25 scheduling data conforming to said first protocol of said minimum rate
26 guaranteed class and of a weighting applied class among said classified classes
27 based on said calculated weighting coefficient to deliver the data in
28 accordance with the scheduling; and
29 scheduling the data conforming to said first protocol of said
30 preferential class, the data conforming to said first protocol after said
31 weighting, and data conforming to said first protocol of a best-effort class
32 among said classified classes such that the data conforming to said first
33 protocol is delivered at a transmission rate equal to or lower than said
34 calculated rate, preferentially scheduling the data conforming to said first
35 protocol of said preferential class, preferentially scheduling the data
36 conforming to said first protocol after said weighting at a timing at which
37 there is no data conforming to said first protocol of said preferential class, and
38 delivering the data conforming to said first protocol of the best-effort class at a
39 timing at which there is no data conforming to said first protocol after said
40 weighting.

1 16. (original) A traffic shaping method, in a network connection system for
2 connecting a communication network and a plurality of user terminals, for

3 shaping a transmission rate for data conforming to a first protocol from said
4 communication network, said method comprising the steps of:
5 classifying data conforming to said first protocol received from said
6 communication network based on quality guaranteed classes set thereto;
7 correcting an overhead amount between a rate based on a second
8 protocol and a rate based on said first protocol to convert received rate
9 information on said second protocol to the rate based on said first protocol;
10 calculating a weighting coefficient based on said calculated rate and
11 the transmission rate for a preferential class among said classified classes
12 determined to be using information fed back from said user terminals such that
13 a minimally guaranteed rate is assured for a minimum rate guaranteed class
14 among said classified classes;
15 scheduling data conforming to said first protocol of said minimum rate
16 guaranteed class and of a weighting applied class among said classified classes
17 based on said calculated weighting coefficient; and
18 scheduling the data conforming to said first protocol of said
19 preferential class, the data conforming to said first protocol after said
20 weighting, and data conforming to said first protocol of a best-effort class
21 among said classified classes such that the data conforming to said first
22 protocol is delivered at a transmission rate equal to or lower than said
23 calculated rate, preferentially scheduling the data conforming to said first
24 protocol of said preferential class, preferentially scheduling the data
25 conforming to said first protocol after said weighting at a timing at which
26 there is no data conforming to said first protocol of said preferential class, and
27 delivering the data conforming to said first protocol of the best-effort class at a
28 timing at which there is no data conforming to said first protocol after said
29 weighting.

1 17. (original) A traffic shaping method, in a network connection system for
2 connecting a communication network and a plurality of user terminals, for
3 shaping a transmission rate for data conforming to a first protocol from said
4 communication network, said method comprising the steps of:
5 classifying data conforming to said first protocol received from said
6 communication network based on quality guaranteed classes set thereto;
7 correcting an overhead amount between a rate based on a second
8 protocol and a rate based on said first protocol to convert received rate
9 information on said second protocol to the rate based on said first protocol;
10 when the difference between the transmission rate for a preferential
11 class among said classified classes determined using information fed back
12 from said user terminals and said calculated rate is lower than a minimally
13 guaranteed rate for a minimum rate guaranteed class among said classified
14 classes, setting an upper limit to the transmission rate for said preferential
15 class for shaping such that the minimally guaranteed rate can be assured for
16 said minimum rate guaranteed class;
17 calculating a weighting coefficient based on said calculated rate and
18 the transmission rate for the preferential class such that the minimally
19 guaranteed rate is assured for said minimum rate guaranteed class, when the
20 upper limit rate is not set for said preferential class, and calculating a
21 weighting coefficient based on said calculated rate and said upper limit rate set
22 for said preferential class such that the minimally guaranteed rate is assured
23 for said minimum rate guaranteed class, when the upper limit rate is set for
24 said preferential class;
25 scheduling data conforming to said first protocol of said minimum rate
26 guaranteed class and of a weighting applied class among said classified classes
27 based on said calculated weighting coefficient; and

28 scheduling the data conforming to said first protocol of said
29 preferential class, the data conforming to said first protocol after said
30 weighting, and data conforming to said first protocol of a best-effort class
31 among said classified classes such that the data conforming to said first
32 protocol is transmitted at a transmission rate equal to or lower than said
33 calculated rate, preferentially scheduling the data conforming to said first
34 protocol of said preferential class, preferentially scheduling the data
35 conforming to said first protocol after said weighting at a timing at which
36 there is no data conforming to said first protocol of said preferential class, and
37 delivering the data conforming to said first protocol of the best-effort class at a
38 timing at which there is no data conforming to said first protocol after said
39 weighting.

1 18. (original) The traffic shaping method according to claim 12, wherein said
2 first communication network is an IP network, said data conforming to said
3 first protocol is an IP packet, said second network is an ATM network, and
4 said data conforming to said second protocol is an ATM cell.